COASTAL STEAM PLANT COOLING TOWER RETROFITS - EFFICIENT AND COST-EFFECTIVE

1. How Critical Are the Coastal OTC Plants to the State's Energy Supply?

The steam boiler plants have low usage rates and contribute only 5% of California's electricity needs. Combined, the 17 coastal plants using OTC in California have a capacity of approximately 21,000 MW.[1] Of this 21,000 MW capacity total, approximately 15,000 MW is natural gas-fired steam boiler plants, 1,600 MW are natural gas combined cycle plants, and 4,200 MW are nuclear plants.[2] The steam boiler plants are old and inefficient and have very low usage rates as a result, averaging under 10 percent in 2006.[3] The power production from the coastal steam boiler plants provided less than 5% of California's power usage in 2006.[4] Only a few of these steam boilers were considered by CAISO in 2007 as essential to ensure grid reliability. These units include Encina (946 MW) and South Bay (689 MW) in San Diego County, Potrero and Contra Costa Units 4 & 5 in the Bay Area, and Humbolt in Northern California.[5]

All coastal steam boiler plants identified by CAISO as essential for reliability in 2007 are already slated for replacement. An air-cooled combined cycle replacement project is proposed at Encina, and an air-cooled combined cycle plant (Otay Mesa) will begin operation near South Bay in 2009. PG&E is constructing an air-cooled combined cycle plant at its Contra Costa plant. The Humbolt plant is being replaced with an internal combustion engine powerplant that does not use water for cooling. The Potrero project is being replaced with the San Francisco Electric Reliability Project, using combustion turbines that do not require cooling water. In addition, approximately 3,000 MW of new combined cycle replacement projects have been permitted at coastal steam boiler plants.[6] Most of these projects have been proposed with air cooling.

2. Is California's Electric Grid Robust Enough to Withstand the Shutdown of Aging Steam Boiler Plants?

Yes, California generation capacity has increased by 7,000 MW since 2001, with another 2,300 MW under construction.[7] In addition, the vast majority of the transmission upgrades identified in the analysis to compensate for once-through cooled plant retirements are relative modest and can be carried-out quickly.[8] The gradual phase-out of inefficient coastal boiler plants would have no impact on reliability and could be realized with minimal additional cost.[9] The April 2008 reliability analysis conducted for California Ocean Protection Council indicates that coastal steam boilers could be retired (if owners choose not to retrofit to cooling towers) with no impact on reliability for as little as $135 million in transmission upgrades.[10] Preliminary CAISO studies that assert that billions of dollars in new transmission investment will be necessary if coastal OTC plants are shut down have no basis in fact.[11]

2. Do Coastal Steam Plants Have New Greenhouse Gas Reduction Requirements?

No. The new legislation applies only to high usage plants, known as baseload plants, and none of the coastal steam boilers are baseload plants. Baseload units operate at or near their rated capacity on a continuous basis. The coastal steam boiler plants are all low usage units, meaning these plants operate only in summer during periods of peak demand. As stated in the language of SB 1368 (Perata, 2006), *"the CEC shall establish a greenhouse gases emission performance standard for all baseload generation . . . at a rate of emissions of greenhouse gases that is no higher than the rate of emissions of greenhouse gases for combined-cycle natural gas baseload generation."*

3. *Will Cooling Tower Retrofits Cause a Drop in Plant Efficiency?*

A very small amount, less than 1% for combined cycle plants and less than 2% for steam boilers. The overall energy penalty of a steam boiler plant wet cooling tower retrofit is less than 2%, not 8% as implied by CCEEB in its March 24, 2006 letter to SLC.[12,13,14,15] The energy penalty for a combined cycle plant retrofit is less than 1%.[16,17]

4. Why Does Industry Imply that the Efficiency Penalty Could be More Than 8%??

Industry incorrectly assumes that an inefficient form of air cooling would be used. Air cooling is easier and less expensive to integrate into new plants, not OTC retrofits. Wet cooling tower retrofits, which involve connecting existing OTC intake and outfall pipes to an evaporative cooling tower where a small portion of the circulating cooling tower is evaporated to reduce water temperature, are more appropriate for the coastal OTC plants as they require little modification to existing plant equipment. As noted, wet cooling tower retrofits impose a small efficiency penalty of 1 to 2% or less. Industry in this case is simply attempting to muddy the water by emphasizing the peak efficiency penalty of an undersized air cooled condenser (8%) and implying this is the technology that will be used in the OTC retrofits. All parties see air cooling as an unlikely candidate for OTC retrofits.

5. Will Controversy Over Availability of Emission Offset Credits Prevent Cooling Tower Retrofits?

No. An existing OTC steam boiler plant that is simply going to continue operating in its current mode while converting from OTC to a cooling tower will not require emission credits. Cooling towers are exempt from South Coast Air Quality Management District (SCAQMD) permit requirements and air emission offset requirements.[18] This means that any OTC coastal plant in the SCAQMD could convert to cooling towers without a need to obtain emission offset credits. Also, there are no coastal plants in the SCAQMD identified by the CAISO as critical "must run" plants for grid reliability purposes.[19] This means that any of the OTC coastal plants located in the Los Angeles Basin that choose not to retrofit to cooling towers could be permanently shut down without compromising grid reliability.

6. How Much Would Air Emissions Increase if the Coastal Boiler Plants Are Retrofit to Wet Towers?

An insignificant amount, less than 1 ton per year NO_x for a typical coastal steam boiler plant. The wet cooling towers would reduce a plant's output by 1 to 2% or less, caused by wet tower pumping and fan energy requirements and a slight loss in steam turbine efficiency.[20] Using the 900 MW Huntington Beach Generating Station as an example, 2% equates to approximately 18 MW. If this 18 MW is "made up" by a modern combined-cycle plant, which consists of a gas turbine cycle and a heat recovery boiler steam cycle and has an efficiency nearly 50% higher than that of coastal steam boiler plants, the annual NO_x and PM_{10} emissions from this 18 MW of additional power output would be a maximum of 32 lb/day and 16 lb/day, respectively.[21,22] The Huntington Beach units have an average usage rate of 15% in 2006. At that usage rate, the annual emissions associated with the efficiency penalty would be 0.9 tons/year NO_x and 0.5 ton/yr PM_{10}.

7. Is Space Available at the Coastal Plants for Cooling Towers?

Yes. Approximately 1 acre of cooling tower footprint is required per 500 MW of steam boiler capacity.[23] In addition, a number of coastal steam plants are considering the co-location of desalination plants. Any steam plant with space available for a large desalination plant generally has adequate space for a wet cooling tower retrofit.[24]

8. What Will Be the Source of Water for the Cooling Towers?

Recycled water is preferred for use in the wet towers. Most coastal boiler plants are located near treated wastewater ocean discharge pipes with adequate water supply for cooling towers operated by nearby coastal cities.[25] The availability of treated wastewater discharge is documented for each coastal OTC plant in the February 2008 TetraTech report on cooling tower retrofits prepared for the California Ocean Protection Council. This water can be cost-effectively disinfected for use as cooling tower make-up water supply. Where sufficient treated wastewater is not available to cover all make-up water demand, supplementing with seawater is also a viable option. The amount of seawater used, even if the cooling tower must use seawater exclusively due to lack of other water resources, would be less than 5% of the seawater withdrawal rate of the existing coastal boiler plant OTC systems. Seawater is used in cooling towers at numerous large steam boiler plants in the United States and Europe.[26]

9. How Much Will the Cost of Power Increase to Cover the Cost of the Cooling Tower Retrofits?

There would be little or no increase in the cost of electricity to consumers. The addition of 7,000 MW of new generation capacity in California in the last several years, combined with transmission upgrades, have made the state less dependent on non-nuclear coastal plants for power, As pointed-out in the IFC Jones & Stokes April 2008 reliability study prepared for the California Ocean Protection Council, The CAISO identified only a handful of coastal units as necessary to assure grid reliability in 2007, and all of these units are being replaced with new units onsite or nearby that do not require water.[27] The owners of the remaining coastal steam boiler plants will either make a business decision to replace these plants with state-of-the-art units to be competitive or permanently shut down. The April 2008 reliability study indicates that for as little as $135 million the grid can be upgraded sufficiently to assure reliable power even if all the once through cooled coastal steam boiler and combined cycle plants are permanently shut down.[28]

[1] ICF Jones & Stokes, *Electric Grid Reliability Impacts from Regulation of Once-Through Cooling in California*, prepared for California Ocean Protection Council, April 2008, Table 3-1, p. 19

[2] Ibid.

[3] Ibid.

[4] Ibid.

[5] Ibid, p. 12.

[6] Ibid, Table 1-1, p. 9.

[7] Ibid, p. 21.

[8] Ibid, p. 4.

[9] Ibid, p. 57.

[10] Ibid, p. 3.

[11] California Independent System Operator, *Impacts on Electric System Reliability from Restrictions on Once-Through Cooling in California – Preliminary California ISO Scenario Analyses*, November 25, 2008, p. 21. CAISO estimates $4.45 billion in transmission upgrades to overset 7,416 MW of OTC plants in Los Angeles Basin and San Diego County.

[12] EPA 316(b) Phase II Technical Development Document, Chapter 5, Sections 5.6.1 through 5.6.3, p. 5-34. The measured annual efficiency penalty at 346 MW Jeffries Station is 0.16%. The cooling tower pump and fan energy demand for steam plants is estimated by EPA at 0.73%. Total energy penalty for Jeffries Stations would be approximately 0.9%.

[13] Rebuttal testimony of William Powers, P.E., DEC # 3-3346-00011/00002, In Matter of Renewal of State Pollutant Discharge Elimination System ("SPDES") permit SPDES # NY-0006262 for 500 MW Danskammer Power Plant, November 7, 2005. Annual energy penalty following retrofit of 235 MW Unit 4 at Danskammer to closed-cycle wet cooling (cooling tower) calculated at 0.6% using site-specific historical Unit 4 OTC performance data and local meteorological data.

[14] March 24, 2006 California Council for Economic and Environmental Balance (CCEEB) letter to Paul Thayer, Executive Director, State Lands Commission. CCEEB states that retrofitting air cooling to 20,759 MW of existing coastal boilers would impose a 1,724 MW energy penalty during critical peak demand periods. This equals an energy penalty of 1,724/20,759 = 8.3%.

[15] EPA 316(b) Phase II Technical Development Document, Chapter 5, Table 5-2, p. 5-2. Summer peak steam boiler efficiency penalty is 1.7%.

[16] Ibid. Summer peak combined cycle efficiency penalty is 0.4%.

[17] TetraTech, *California's Coastal Power Plants: Alternative Cooling System Analysis*, prepared for California Ocean Protection Council, February 2008, Chapter 7, p. F30-F31, p. J29-J30.

[18] SCAQMD Rule 219, *Equipment Not Requiring a Written Permit*, (d)(3) –cooling towers.

[19] ICF Jones & Stokes, *Electric Grid Reliability Impacts from Regulation of Once-Through Cooling in California*, prepared for California Ocean Protection Council, April 2008, p. 12.

[20] Ibid.

[21] CARB, Guidance for the Permitting of Electric Generation Technologies, Stationary Source Division, July 2002, p. 9 (NO_x emission factor = 0.07 lb/M-hr combined-cycle plants).

[22] San Diego County Air Pollution Control District (APCD), Otay Mesa Power Project (air-cooled), Authority To Construct 973881, 18 lb/hr particulate without duct firing (510 MW output), equals ~ 0.04 lb/MW-hr.

[23] Direct testimony of William Powers, P.E., DEC # 3-3346-00011/00002, In Matter of Renewal of State Pollutant Discharge Elimination System ("SPDES") permit SPDES # NY-0006262 for 500 MW Danskammer Power Plant, October 14, 2005. Testimony describes design basis for retrofit plume-abated tower measuring 50 feet by 300 feet for 235 MW of steam plant capacity. Inline wet cooling towers can provide approximately 500 MW of steam boiler plant cooling capacity per acre (210 feet by 210 feet area).

[24] For example, a 50 million gallon a day desalination plant is under evaluation for an 11-acre site at the AES Huntington Beach steam plant [ref: City of Huntington Beach, Seawater Desalination Project at Huntington Beach - Draft Recirculated EIR, May 2005, p. 3-1]. Units 3 and 4 steam units at Huntington Beach, a total of 450 MW, were recently repowered [ref: CEC, Huntington Beach project description, http://www.energy.ca.gov/sitingcases/huntingtonbeach/index.html]. Less than 2 acres of land would be needed for inline wet towers for Units 3 and 4.

[25] Huntington Beach Generating Station (HBGS) is a 900 MW steam boiler plant that would require approximately 12 million gallons per day of fresh cooling tower make-up water if retrofit with cooling towers (July 29, 2006 Powers Engineering report, *Assessment of Closed-Cycle Wet Cooling Retrofit Feasibility at HBGS*, prepared for Surfrider Foundation). The Ocean County Sanitation District (OCSD) discharges 240 Mgd of treated wastewater via an ocean outfall pipe that passes less than 2 miles from HBGS. This water is available for use by HBGS but would require disinfection before use in a cooling tower. The equipment cost for 12 Mgd of in-line chlorination treatment capacity is approximately $2 million, and O&M cost approximately $0.2 million/year, based on pro-rated 2005 cost data from an Orange County Sanitation District study of disinfection options for OCSD treated wastewater discharged to the ocean. [cost data from: A. Tobin, J. Burror, *Alternatives for Disinfecting Effluent Generated at OCSD Wastewater Treatment Plants*, presented at Water Environment Foundation WEFTEC 2005 Conference, Oct. 29 – Nov. 2, 2005, Washington, DC]

[26] Dr. Shahriar Eftekharzadeh – Bechtel, *Feasibility of Seawater Cooling Towers for Large-Scale Petrochemical Development*, Cooling Technology Institute Journal, Summer 2003, Vol. 24 No. 2, pp. 50-64. The author notes that operators of seawater cooling towers have not reported any problems associated with salt drift at their facilities, and that site inspections of two long-time saltwater cooling tower installations did not exhibit any visible signs of salts fallout.

[27] Encina Units 4 and 5 are the exception to this statement. These two units are identified by CAISO as necessary for grid reliability and will not be replaced in the scope of the 550 MW combined cycle project proposed for the site. The South Bay Power Plant will not be replaced at its current site. However, the 562 MW Otay Mesa combined cycle plant is located within 10 miles of the South Bay Power Plant and is expected to begin operations in 2009.

[28] ICF Jones & Stokes, *Electric Grid Reliability Impacts from Regulation of Once-Through Cooling in California*, prepared for California Ocean Protection Council, April 2008, p. 3. "The less severe case of all OTC plants except the nuclear units retiring in 2015 showed that the retirements could be compensated for with as little as $135 million in in-state transmission system upgrades."